IMAGE PROCESSING SOFTWARE

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ABSTRACT: A brief description of astronomical image processing software is presented. This software was developed in a Digital Micro Vax II Computer System.

RESUMEN: Se presenta una somera descripción del software para procesamiento de imágenes. Este software fue desarrollado en un equipo Digital Micro Vax II.

Key words: DATA ANALYSIS — IMAGE PROCESSING

I- INTRODUCTION:

From the mathematical view point an image can be represented by a 2-dimensional function $I(x,y)$ defined in a certain domain: $0 \leq x \leq r$, $0 \leq y \leq s$. According to this model a digital image is given by an rxs-dimensional array where each value is the brightness of an image point. This array is obtained from a 2-dimensional scanning of a photographic plate. A 2D-microdensitometer is needed for this purpose. As a result a sequential file containing the information is obtained.

II- SOFTWARE DESCRIPTION:

The system is structured in blocks as follows:

II.I Data base:

the microdensitometer output files (sequential format) must be packed before being used by the system. The packing operation causes the ouput files to be smaller than the original by 50%. The packed file has N1 records each of them containing N2 fields. N1 and N2 are respectively the row and columm numbers selected during the scanning procedure. Each numerical value in the original file is converted to its ASCII value in the output one.

II.II- Processing system:

This is the execution block of the system in which the image processing is done. The user interacts with the system through the following commands:

- NEWIMAG:

Loads an image to memory and sets it as active or program image: first the system asks for file name; then the reading operation is executed.

- SENS:

Calculates the intensity array from the density array using the sensitometry file. The computation includes the average determitation in each step, the aproximation of the resulting point by a least-squares procedures and the density array conversion.

- HISTOGRAMA:

The image histogram is a powerful tool in image processing because it provides statistics information about the object in image. This command gives the possibility of calculating and drawing the image histogram.

- CONTRASTE:

This command is used to produce an image enhancement with a grey-level transformation. This operation is performed by a direct mapping of the original levels in others: this new levels are selected by determining the transference function.

- ECUAL:

This command is used to perform the active image histogram equalization. This procedure can be done by two ways:

UNIFORM: the output histogram is equivalent to one characterized by a gaussian distribution.

NON-UNIFORM: The output histogram shape is defined by the user.

In the first way the output levels W_k are given by:

$$W_k = \sum_{j=0}^{k} P_z(z_j) \quad \text{or} \quad W_k = \sum_{j=0}^{k} n_j/n$$

In second one a double transformation is needed: first a uniform equalization on input histogram, then a uniform equalization on output histogram and at last a composed mapping to have the output levels.

- SUAVIM:

This command makes image smoothing on the active image. It can be done by two ways:

- MEAN-VALUE FILTER :is the convolution operation between the active image and the pattern:

$$\begin{array}{ccc} 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \end{array}$$

The central pixel is replaced by the average of itself and its eight neighbors if the diference between the new value and the original is smaller than a user specified threshold and not changed othewise.

- MEDIAN-FILTER : each pixel is replaced by the median of itself and its eight nearest neighbors.

- ZOOM:

This command gives the active image ampliation and it can be done by two ways:

-WITHOUT INTERPOLATION :each original pixel is replaced by four identical pixels in the resultant image.

WITH INTERPOLATION : everyone of the tree new pixeles is obtained by a 2-dimentional interpolation of the original ones.

- PERFIL:

This command computes and draws the intensity profile in both directions : horizontal and vertical.

- REALCE:

This command gives the active image objects boundaries enhancement. This operation computes the convolution between the active image and a pattern that varies with the selected filter type. The posibilitys are:

$$\text{DIRECTIONAL FILTERS} \begin{bmatrix} \text{NORTH} \\ \text{SOUTH} \\ \text{EAST} \\ \text{WEST} \end{bmatrix} \quad \text{NON-DIRECTIONAL FILTERS} \begin{array}{l} \\ \text{LINE FILTERS} \end{array} \begin{bmatrix} \text{FOUR NEIGHBORS} \\ \text{EIGHT NEIGHBORS} \\ \text{LAPLATIAN} \end{bmatrix} \begin{bmatrix} \text{HORIZONTAL} \\ \text{VERTICAL} \end{bmatrix}$$

- STORE:

Stores the active image or a pattern in one of the three memory pages.

- OPERAR:

Performes arithmetical (addition, substraction) or logical (and, or) operations between active image and a memory page.

II.III Output:

This block transfers the processed information to output devices. Output devices are 4107 Tektronix Graphic Terminal, LNO3 printer and Houston Plotter.

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